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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service	)	MM Docket No. 87-268

To: The Commission

COMMENTS OF PCUBE LABS

Professional Products & Promotions, Inc.[1], a Florida Small Business Corporation doing business as PCUBE Labs, hereby comments on the Fifth Further Notice of Proposed Rule Making (the "Fifth NPRM") in the above-captioned proceeding.

1. Introduction

According to the Fifth Further Notice of Proposed Rulemaking in this proceeding, the Commission is considering the adoption of the recommendations of the Advisory Committee on Advanced Television Services (ACATS), without modification, as submitted. The Fifth NPRM specifically requests comments about both the technical and implementation

1 These comments have been prepared by Mr. Craig Birkmaier, President of PCUBE LABS, a technology consultancy dealing with the convergence of video, computer and telecommunication technologies. PCUBE has been intimately involved with the development of computer based tools for digital video editing and image composition with clients including: Avid Technologies, Scitex Digital Video, LucasFilms, Hewlett Packard, Adobe Systems and IBM. Mr. Birkmaier is actively involved in the development of new markets for visual communication products as a contributing editor to Videography and Television Broadcast magazines, and through his extensive involvement in standards work related to the convergence of video and computer technology and advanced television systems. Mr. Birkmaier was a participant in the ACATS Working Party 4 interoperability review of the proposed ATSC standard, a member of the ATSC working group on studio production standards, and a frequent contributor to ACATS and ATSC activities related to development of the proposed ATSC standard. These comments reflect the position of PCUBE Labs and Mr. Birkmaier, and do not represent the views of any other company or individual.

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aspects of deploying a digital terrestrial broadcast standard for advanced television services, the standard documented by the Advanced Television Systems Committee (ATSC).

Numerous responses to this Notice raise serious questions with regard to various aspects of the proposed standard. It is not the intention of these comments to analyze specific technical issues in depth. These issues are well documented in other submissions to this Notice. They are also well documented in submissions made by Mr. Birkmaier and many others during formal ACATS and ATSC reviews over the past four years.

There is a common theme to these submissions, however, which points out the serious potential consequences of mandating the proposed standard. This proposal is a collection of technologies that have been chosen through a competitive process and plugged-into a very flexible framework for digital broadcasting. As such the proposed standard seeks to assure interoperability at the receiver level and the long term viability of the standard by choosing technology winners and deploying a new digital television infrastructure modeled on the analog infrastructure it seeks to replace.

This approach is likely to stifle innovation and the rapid development of new services and technologies. For example, the response to this Notice from Digital Theater Systems points to the fact that a digital broadcast standard could support multiple audio encoding technologies, and that the technology choosen by ACATS for this system function may already be dated. The same can be said for virtually every other modular component of the proposed standard.

The FCC regulatory process is simply not up to the challenge of constantly evolving the standards for new services that can be carried via a digital terrestrial broadcast system that delivers bits to intelligent information appliances in both fixed and mobile applications. The obvious solution is to develop a modular, layered framework for an open systems approach to digital television, and let the marketplace drive the evolution of this service by constantly improving functionality within the modular components of the architecture.

The following comments and recommendations will attempt to avoid dealing with the complex issues, and focus on solutions instead. A recent article, published in Videography magazine is included as Appendix 1 to these comments; the article deals with some of the fundamental issues of interoperability raised in the responses to this Notice.

These recommendations are being submitted for consideration, with the hope that they will provide a framework which the Commission can use to move towards the goal of harmonizing the requirements of all affected stakeholder industries in a time frame that will allow digital broadcast licenses to be issued according to the Commission's current timetable.

2. Specific Recommendations

2.1 Modulation Standards

There are two critical issues with respect to the establishment of modulation standard(s): interference with NTSC channels in adjacent markets during the simulcast period; and the ability for broadcasters to choose modulation techniques that are appropriate for their markets as the underlying technolgies evolve.

The Commission should establish a modular framework for modulation standards. It should allow digital broadcast license holders to choose 4VSB at a reduced initial operating power level, or 8VSB at full authorized power level, based on adjacent market conditions during the simulcast period. The Commission should allow broadcasters to choose from additional modulation standards when the NTSC channel is returned, according to market dictates.

2.2. Transport Protocols

The proposed MPEG-2 transport protocol does not provide sufficient error protection to assure reliable delivery of data files, such as those that are currently used in computing and Internet applications.

The Commission should establish a modular framework for data transport protocols. The proposed MPEG-2 transport layer can be recommended for use during the simulcast period. The Commission should encourage stakeholder industries to work together to develop enhancements to the proposed MPEG-2 transport or alternative transport protocols that ensure the delivery of critical data at the higher bit error rates required for the transport of "lossless" data files; these industries should submit a harmonized proposal to the Commission no later than January 1, 1997.

2.3. A Market Driven Approach To Applications

The Commission should allow the marketplace to guide and affect the development of applications that can be delivered via the transport protocol(s) established following the recommendation noted above. The commission should not mandate any receiver requirements or minimal hours of broadcast for any proposed video format. The commission can "endorse" the application layers of the proposed ATSC Standard as an available application that broadcaster may freely choose to use for ATV services, but should not preclude the use of other formats.

2.4. An Alternative to a Free Market Approach

If the commission feels compelled to mandate that digital broadcast license holders must originate a specific format to ensure rapid adoption of the standard, it should establish a minimum base-layer standard for a format family with:

- 480 vertical lines;
- An orthogonal sampling grid (square pixels);
- Frame-based sampling (progressive scan);

- Variable aspect ratio within a range from 1:2 to 2:1 (H:V); images outside this range can be encoded with reduced vertical resolution (lettterboxed presentation);
- Variable frame rates based on a 6 Hz family which may include 24, 36, and 60 frames per second.

A "reference" digital television receiver should be capable of decoding and displaying a central 640 x 480 (4:3 aspect ratio) region of this base layer at frame rates up to 60 frames per second

2.5. Encourage Industry to Step Up to the Task

The Commission should strongly encourage cross-industry collaboration, to harmonize the requirements of various stakeholder industries, by developing voluntary standards or recommended practices to guide both program distributors and consumers in the selection of appropriate technologies. The Commission should encourage these industries to develop recommended practices that will deal with the following issues:

2.5.1. Public Interest Information Services

The Commission and Congress have required television receiver manufacturers to support current services such as closed captioning for the hearing impaired and emergency messaging systems. It is recommended that the Commission encourage the stakeholder industries to support these requirements on a voluntary basis and significantly expand the scope of services that can be expected from a receiver that complies with the voluntary standards and practices. For example, the system should support program rating and blocking functions--the so-called "V-chip". The recommended practices would provide a foundation for minimal compliance with ancillary data broadcasts that contain public interest information.

Stakeholder industries should be encouraged to develop a plan for receiver addressability--for example, the assignment of an IP (Internet Protocol) address--so that messages can be delivered to any group of, or individual receivers, via any communications infrastructure including terrestrial broadcast. In addition to the traditional information services described previously it would also be highly desirable to support the ability to forward mail to receivers for applications such as messaging from schools and local governments to citizens in the community.

2.5.2. Voluntary standards for identification of critical receiver characteristics

The consumer, when purchasing a receiver/display system should be provided with information that identifies the capabilities of the receiver/display and levels of compatibility with existing standards and recommended practices Characteristics which should be identified include:

- Display resolution (Horizontal and vertical resolution as measured in cycles per degree for recommended viewing distance(s);
- Aspect ratio, including the capabilities of the receiver to accommodate other aspect ratios;
- Supported video decoding capabilities;;
- Supported audio decoding capabilities;
- Supported graphics and local information synthesis capabilities;
- Supported communications capabilities (demodulation standards);
- Support for extensibility--the ability to enhance the performance of the receiver through plug-in hardware and software upgrades or software enhancements delivered as ancillary data.

2.5.3. Voluntary standards for the encoding of both linear and interactive program content, providing a flexible foundation to support all forms of source material, including new forms of content that are yet to be identified.

3. Conclusion

The Commission should encourage the participants to develop a modular, layered architecture that can be freely extended as the underlying technology evolves. The Commission should encourage the immediate formation of a suitable cross-industry group to deal with these issues and ask for a preliminary report form this group to be delivered by January 1, 1997. The Commission should provide a representative to sit as an ex-officio member of the group to enhance communications between these bodies and expedite requests for information regarding FCC policies and regulations.

Respectfully submitted, Craig J. Birkmaier

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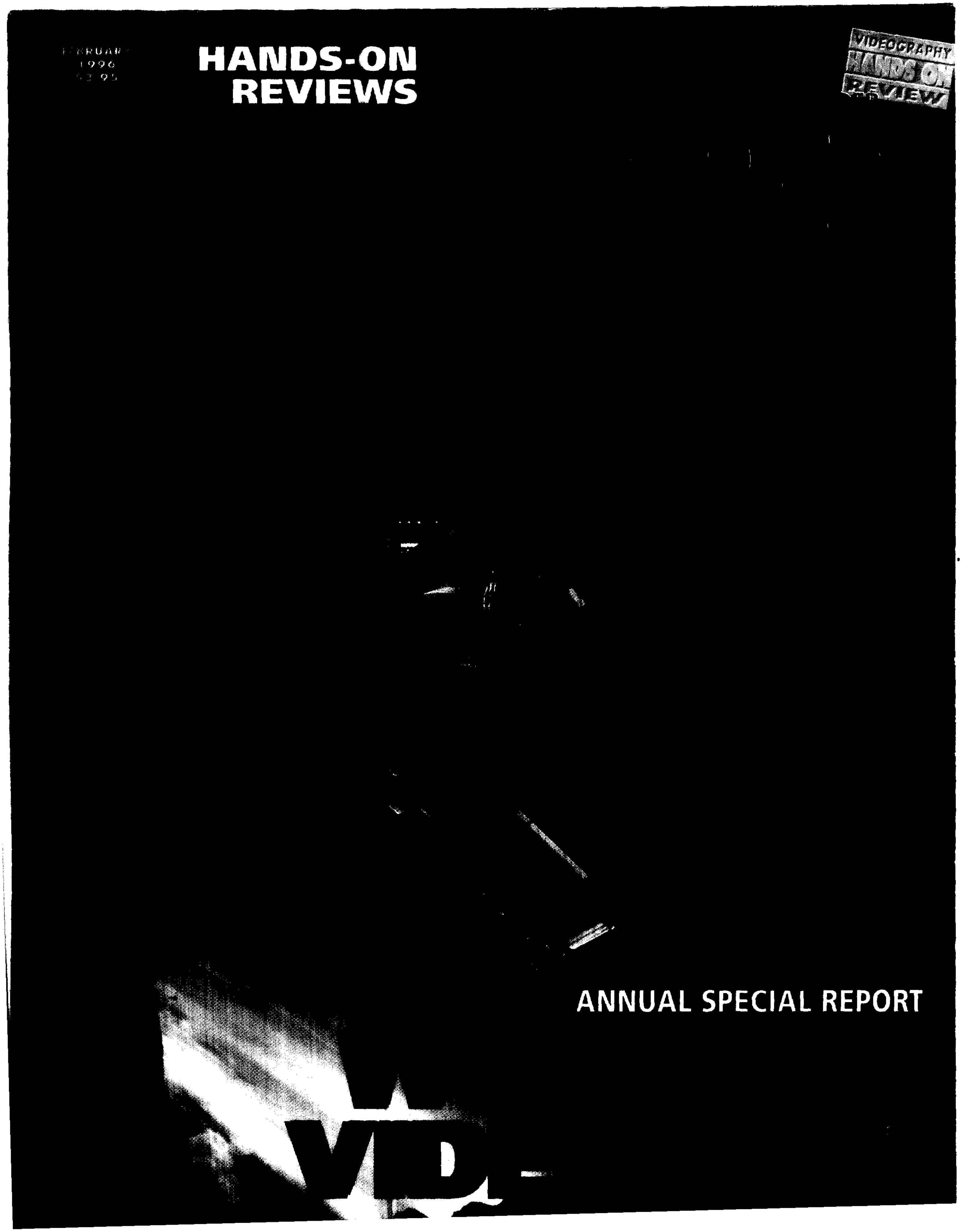
July 11, 1996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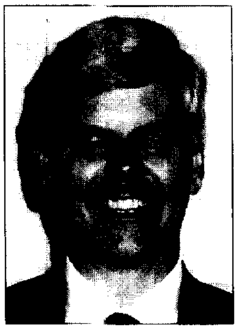
Crossfire: Contrasting Opinions on Convergence

CRAIG BIRKMAIER



What do the HDTV Grand Alliance, a computer industry coalition, and some Contributing Editors to this magazine have in common?

The answer is contrasting opinions about *what* people will be watching on electronic information displays as personal computers, the Internet, and DTV (digital television) converge and the content available to each looks increasingly the same.

For months I have been exploring aspects of the *user interface* to interactive DTV in this column, describing how converging video and computer technologies can be applied to resolve some of the issues that have fueled an intense debate about *interoperability* between video and computers. In my October "Fun with Macroblocks" column, I presented the views of Apple Computer's Dr. Donald Norman on the subjects of convergence and interoperability, adding my own point of view:

"Clearly, there has already been significant convergence between the TV and the PC. For all intents and purposes, DTV is a PC. As pointed out by Apple's Norman, however, applications and usage will dictate the form factor for the information appliances of the future, just as applications and economics differentiate the desktop computers used in video project studios from the workstations used to produce effects for motion pictures. The major benefits of convergence flow from the integration of traditional in-home information and entertainment functions, including television, telecommunications, and computing.

In November VIDEOGRAPHY Technical Editor Mark Schubin provided additional insights to this debate in his column "A Bird In The Bush?" In that column, Schubin raised questions about the value of integration and advanced a counter-argument to the *convergence* of the computing, film, and video industries:

"There is one area, however, in which convergence does not yet seem to be occurring, despite optimistic predictions of information appliances and the like. That area is how people *view* computer, movie, and video screens."

As a follow-up to the "Fun With Macroblocks" series I had planned to write a column on the subject of *display scalability*. After reading "A Bird In The Bush?" I was elated! Schubin's column provides the perfect set-up for a discussion of this important concept, explaining important technical, environmental, and sociological differences in the way computer, movie, and television screens are viewed. These factors led Schubin to conclude:

"The old adage has it that a bird in the hand is worth two in the bush. Consumers currently have two birds in hand—home computers and TV sets. What compelling reason will cause them to give them up for a single elusive bird in the bush?" (See "Bless You, Tiny TIMM," page 116.)

With Schubin's column as "reference material" I'm now prepared to tell the display scalability story, and in so doing, attempt to answer his question.

One Size Does Not Fit All

A year ago, at the Advanced Television and Electronic Imaging Conference of the Society of Motion Picture and Television Engineers (SMPTE), I presented a technology demonstration entitled "One Size Does Not Fit All," together with Gary Demos. Demos has been an active participant in the Advanced Television process as a consultant for Apple Computer. A variety of displays, including a direct-view CRT and both LCD- and CRT-based projection systems, were placed side by side. The displays varied in screen size, aspect ratio, and source image resolution, but they were configured to share a common feature; each display delivered approximately the same level of *perceived resolution* to viewers in the audience.

In his November column Schubin described three viewing applications: computer, television, and movies. The computer application typically involves a small display with a short viewing distance. Television is typically viewed on displays of moderate size at moderate viewing distances. Theater screens are typically large and viewed from the longest distance. He went on to explain:

"If the viewing distances match the screen sizes just right the retinal angles of all three could conceivably be constant (i.e., the images on the rear of the viewers' eyes could be the same size)."

What Schubin described is the concept of display scalability. One purpose of the SMPTE demonstration was to illustrate this concept, and the fact that source-image resolution should be scaled for the viewing application to deliver what is perceived by the viewer as a sharp image. In other words, one size does not fit all.

If the source-image resolution is too low the image may appear *soft* on larger digital video interfaces," explains Yvan Ouellet, VP, Sales and Marketing for the company. "The product we are developing for the Movie-2 bus is our third major collaboration with Matrox." Miranda has provided lots of feedback to Matrox over the years and feels certain that the Movie-2 bus is a true broadcast standard that will work for both manufacturers and users.

"Everyone recognizes the need for a separate bus that is not tied to the actual platform you are using," says Ouellet. "For computer manufacturers, the cost of implementing a full 4:2:2 bus on every machine is excessive and unnecessary. Movie-2 bus will help end users get a full broadcast quality system working on a non-video platform."

The biggest advantage of the Movie-2 bus, says Ouellet, is that "the level of quality (from PC workstations) will increase significantly." It will also give more people access to the technology, which can eventually lower prices. "We all want to bring the entry level (for broadcast video production) low enough that anyone can have access to it." If we can do that, adds Ouellet, "we may be able to ship millions of systems."

Access to more users is one of the things that attracted OptiVision to the Movie-2 bus. "We hope there will be other vendors building products to this, so that if we need to go into a specific market and need an input board, for example, we could pick an existing product and improve our time to market," says Ralph Mele, OptiVision's Executive VP of Sales and Marketing. "It also opens up the market for boards that will let people do interesting things with video signals before they get to our products."

OptiVision has a fairly sophisticated, proprietary bus structure in their current products, but the Movie-2 bus is similar. "If Matrox wants to promote this and people develop against this standard," states Mele, "it benefits the industry in general." It can also let people play off one another's strengths. "We are good at encoding and decoding," he explains, "but we are not experts in everything. This can give us a choice of other people's cards to marry to our technology."

Just as important to Mele is the capability OptiVision can give to other companies. "Some of the people building these boards don't have encoding capability," he says. "Our card will be attractive to them for an OEM basis, which will move us more into the integrator and OEM business."

Although it's still too early to tell, it looks like there is enough development being done for the Movie-2 bus to ensure a major showing at this year's NAB. Even if the list of companies willing to talk at this point is small, Matrox strongly implied that the complete list of companies supporting Movie-2 reads like a Who's Who of the video industry. Let's hope they tell us who they are before we get to Las Vegas, so we can see for ourselves how many screens the Movie-2 bus is playing on.

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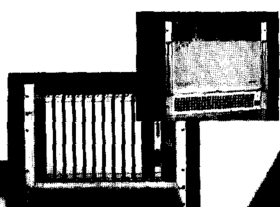

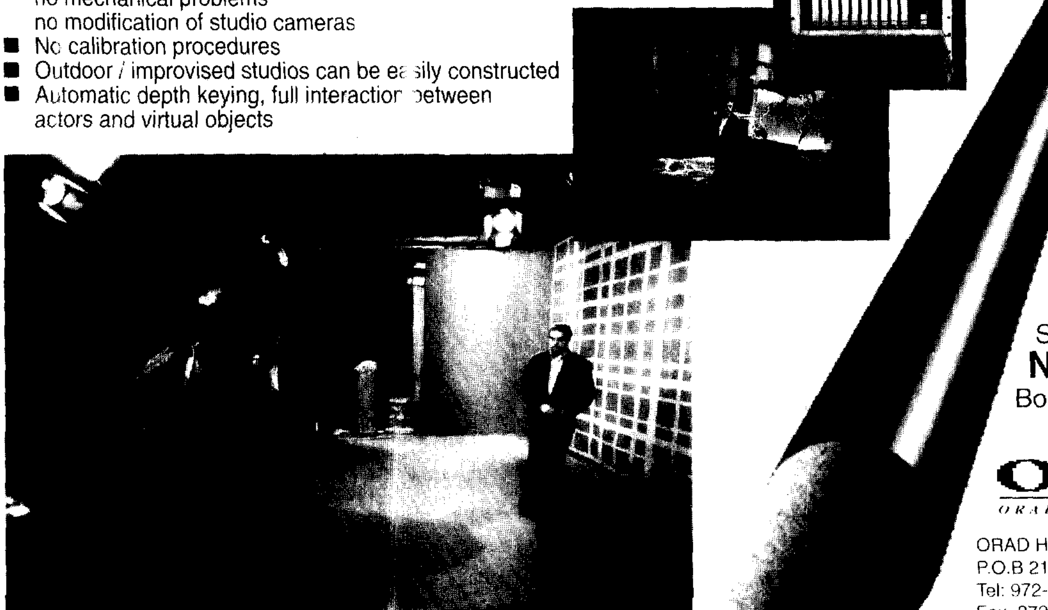

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displays and the image sampling structure may be visible. If the source-image resolution is too high the viewer may not be able to resolve all of the available detail at the preferred viewing distance for the display (see "The Sharper Image?" page 118).

Analog television standards such as NTSC and PAL were optimized to deliver one level of resolution, although this level of detail is not always present in all source imagery. The proposed ATV standard has been designed to deliver multiple levels of resolution; there are 17 proposed formats with multiple levels of both spatial and temporal resolution. What follows are the proposed spatial sampling structures (and aspect ratios) for each format and the field/frame refresh rates (**I** indicates interlaced scanning and **P** indicates progressive scanning):

- 640 x 480 (4:3) @ 24P, 30P, 60P and 60I;
- 704 x 480 (4:3 and 16:9) @ 24P, 30P, 60P and 60I;
- 1280 x 720 (16:9) @ 24P, 30P, and 60P;
- 1920 x 1080 (16:9) @ 24P, 30P and 60I.

The first two levels are referred to as standard definition (SDTV), while the other levels are considered to be high definition (HDTV). The 704 x 480 formats are based on 720 x 484 sampling defined by CCIR-601—samples are dropped at the edge of the pictures. The 704 x 480 formats can utilize an anamorphic squeeze for 16:9 source imagery; 4:3 and 16:9 displays will rescale the squeezed source for full-screen or letterbox display. The use of interlaced scanning—especially in the SDTV formats—continues to be the subject of intense debate among representatives of the computer and video industries (see "The Sharper Image?" page 118).

Several years ago I developed a chart that illustrates the display scalability concept. It was published in the *SMPTE Task Force Report On Digital Image Architecture* and reprinted in the December 1992 *SMPTE Journal*. The chart—EXAMPLE 16 X 9 ASPECT RATIO DISPLAYS—is reproduced at right, on page 117, to explain the variables that should be taken into consideration when designing a display system for a specific application. The chart specifies the average field of view covered by the display at the specified viewing distances, and the maximum perceived resolution in cycles per degree (cpd), which can be delivered under these conditions. If you're not familiar with these variables, here's an explanation from the Task Force report:

"The perceived resolution of a display is determined primarily by the viewing distance and the visual acuity of

BLESS YOU, TINY TIMM

The photograph at left was taken at Two Head Film and Video, in Gainesville FL. The computer-generated image on the 17-in. display on the left has 1,024 x 768 pixels, all of which can be viewed—when I put on my reading glasses. The computer-generated video image on the 20-in. display on the right has 640 x 480 pixels; about ten percent of these pixels cannot be seen because of overscan.

If you were to sit in front of this configuration and edit a television program, I'm virtually certain you would find this set-up uncomfortable. These displays are designed for use at different viewing distances. It would help if the information on the computer display were larger and the television display was either smaller or was moved back about four feet. In a recent informal survey of people using desktop nonlinear editing systems, I learned that a 13-in. video display—in the same focal plane as the computer display—is considered to be "just right."

I'm especially intrigued by the display on the right in the photo, as it represents the first in a new generation of multiple-use information displays. This type of display *may* prove to be an evolutionary bridge to higher resolution digital television, providing enhanced interoperability with local and networked computing applications. I'm especially disappointed that it was designed for the *preferred* distance for viewing television—in Japan.

This display was designed for optimal viewing of television *and* recorded movies *and* a computer, all at the same viewing distance. It is manufactured by Toshiba and sold as TIMM (Toshiba Integrated Multimedia Monitor); the "street price" is about $750. The multisynchronous display can switch between TV, video, and RGB modes. The CRT has a .59mm aperture grill pitch, which is comparable with the tubes used in premium 20-in. television receivers. Like TIMM, these receivers claim to deliver about 500-TV line resolution and include an S-Video input to connect a signal capable of delivering this much detail. Unlike a television receiver, however, the RGB mode is designed for use with personal computers—640 x 480 at 60 Hz progressive scan for VGA or the Mac's 66.7 Hz vertical refresh rate.

As noted previously, TIMM is too big for the 20 to 30-in. preferred viewing distance for a computer display. And it's too small for the seven to ten-foot television viewing distance preferred in American homes. It is, however, "just right" for the five-foot viewing distance preferred in Japanese homes. Toshiba is testing the waters here in the U.S. to see if there's an appetite for multiple use displays. Perhaps we will learn *if* there is a market for this kind of display system when someone introduces a 27-in. or larger display designed to accommodate the preferred viewing distance for television in the U.S. Rumor has it we won't have to wait very long to find out.

—CRAIG BIRKMAIER

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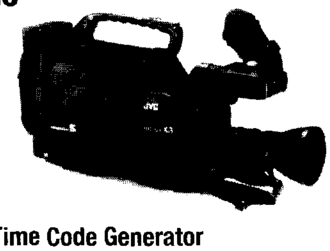

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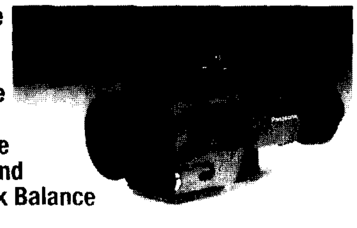

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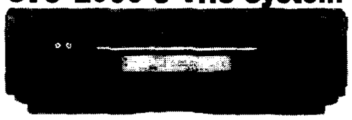

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the observer. Visual acuity is often determined using sets of alternating black and white lines of equal width. One black/white line pair represents one cycle. The number of cycles that can be resolved across one degree of the eye's viewing field is typically used as a measure of human visual acuity, and is stated in cycles (line pairs) per degree. Under some conditions, with high-contrast line pairs, human visual acuity extends beyond 40 cpd; approximately 22 cpd is perceived as a sharp image."

The chart defines the parameters needed to provide identical views of imagery (at four levels of resolution) in three information display venues. A few points of reference are useful when looking at this chart:

- NTSC television can be characterized as Level 1—Low Resolution—or Level 2—Normal Resolution—depending on the viewing distance, the type—black-and-white or color—and the resolution specifications of the display (e.g., the dot pitch of the aperture grill on color displays). The 4.2 MHz luminance bandpass of NTSC permits about 22 cpd of detail when viewed on a black-and-white display that covers a ten-degree field of view.
- A 640 x 480 progressive-scan computer display can be characterized as Level 2—Normal Resolution—it can deliver about 50 percent more vertical resolution than an interlaced NTSC display when both cover a ten-degree field of view (see "The Sharper Image," page 118).
- The design criterion for the Grand Alliance HDTV system lies within Level 3—High Resolution. A designed viewing distance of 3 to 3.3 picture heights is recommended for viewers to perceive this level of resolution. At this viewing distance the proposed 1,920 x 1,080 HDTV format would deliver approximately 30 cpd resolution and a 35 degree field of view. This *exceeds* the resolution delivered by almost every high-end computer workstation display in use today.

Resolution Level	Average Field of View	Average Viewing Distance	Target Display H x V (rounded)	Pixels H x V (square)	Approximate Resolution cycles/degree
Level 1 Low Resolution	25°	30″ 76 cm	12″ x 7″ 30 x 18 cm	512 x 288	10
Level 2 Normal Resolution	25°	30″ 76 cm	12″ x 7″ 30 x 18 cm	1024 x 576	20
Level 3 High Resolution	35°	30″ 76 cm	19″ x 11″ 48 x 28 cm	2048 x 1152	30
	50°				20
Level 4 Ultra High Resolution	50°	30″ 76 cm	28″ x 16″ 71 x 41 cm	4096 x 2304	40

AVERAGE VIEWING DISTANCE

Distance	Applications
30″ 76 cm	Personal and Computer Displays

Viewer

Example 16 x 9 Aspect Ratio Displays

Trying To Make A Point

Consider the following question. How big is nine-point type?

If you answered, "a distance of 9/72 or 1/8 inch from the baseline of the font to its highest excursion," you're correct. Professional typography is a very exacting science. There are 12 *points* in a *pica* and six picas per inch. That's 72 points per inch. This number should sound familiar, since it formed the basis for the revolution in desktop publishing and electronic pre-press—WYSIWYG.

"What you see is what you get" was the battle cry that liberated commercial artists from their razors and paste-up page-composition boards. The original Apple Macintosh display delivered 72 addressable pixels or dots per inch (dpi), as measured on the screen. Therefore, type and graphics designed using the *point* — the typesetters' basic unit of measurement — appeared to

be the same size, although at much lower resolution as the final printed document.

Today artists use relatively low-resolution 72 dpi computer displays to visualize page compositions on a computer, then output these pages at higher resolutions—typically 300 to 2,540 dpi—on a computerized imagesetter. To read what we print on these pages the designers assume you will hold this magazine at the normal viewing distance for reading. With my "failing" middle-age vision the ability to read these pages, and computer displays like the one in "Bless You, Tiny TMM" (see page 116), requires the magnification power of reading glasses.

Here's another question. How big is the type you see when a video camera is pointed at a page of nine-point text, or when nine-point text is generated with a computer-based videographic system. If you answered "It depends," you're correct. It's nearly impossible to say exactly how large the text will appear to the viewer. There are multiple interacting variables that can affect the size of the text you see:

- the distance from the camera lens to the page and the focal characteristics of the lens—especially the current level of magnification (zoom setting);
- the target resolution, measured in dots per inch, used when a computer program generates a raster version of a character at a specified point size
- subsequent scaling of the image with video processing hardware or software;
- the size of the video screen;
- and the viewing distance.

In other words, telling someone that they are looking at nine-point type on an electronic display is only true when all of these conditions are properly controlled, yet this is exactly what the Grand Alliance did when they demonstrated their system to the Federal Communications Commission (FCC) and those who attended an FCC hearing concerning the U.S. Advanced Television standard, held December 12 in Washington DC. One portion of the demonstration was intended to quiet lingering concerns about interoperability with computers, based on the use of interlace in three of the proposed HDTV and SDTV formats.

A few observations about this set-up are needed to understand the technical sleight-of-hand. The room was nearly dark, like a movie theater. The main 1,920 x 1,080 interlaced HDTV image was projected on what appeared to be a 10-to-12-ft. diagonal screen. I positioned myself at what I estimated to be

(continued on page 130)

THE SHARPER IMAGE?

At the recent FCC hearing on ATV services CICATS indicated that certain aspects of the proposed Grand Alliance standard would erect significant barriers to interoperability with computers and other components of the emerging national Information Infrastructure. CICATS recommended that all ATV formats utilize progressive scanning and square pixels, and that the standard should include support for the higher display refresh rates—above 70 Hz—utilized in most new CRT-based computer displays.

These complaints are certainly not new. They have been stated consistently throughout the ATV process, by myself, representatives of Apple Computer, and by Jae Lim, who represents the Massachussettes Institute of Technology in the Grand Alliance. A 1993 interoperability review conducted by the Advisory Committee on Advanced Television Services—in which we participated—found that progressive scan and square pixels are essential prerequisites for interoperability. What is new, however, is that most of the other major players in the computer industry have joined Apple in raising concerns about the proposed ATV standard.

Each of these issues has been the subject of intense debate during the five years I've been involved with the ATV process. None, however, has been debated—or misunderstood—more than interlaced versus progressive scanning. Technical concepts such as the Kell factor, interlace factor, modulation transfer function, Nyquist limits, and Shannon's sampling theorem are often thrown around with reckless abandon to justify the advantages of one form of image acquisition and/or display over the other. The subject is further confused by emerging display technologies such as active matrix LCD and Texas Instruments' DMD (digital micromirror device), which utilize essentially constant illumination of all pixels rather than a scanning spot of light.

While the Grand Alliance, video equipment manufacturers, and many broadcasters acknowledge the advantages of progressive scanning, they contend that interlace is still necessary to deliver HDTV *and* SDTV through the new digital broadcast channels. Progressive scan is their stated long-term goal. For now, they claim the reduced bandwidth and improved camera sensitivity afforded by interlace are necessary to launch DTV.

I cannot hope to properly address this subject in the limited space remaining in this column. Perhaps Mark Schubin will treat us to an analysis of this subject in the near future. Instead, I'll attempt a brief description of some important factors and recent research that is shedding new light on this debate.

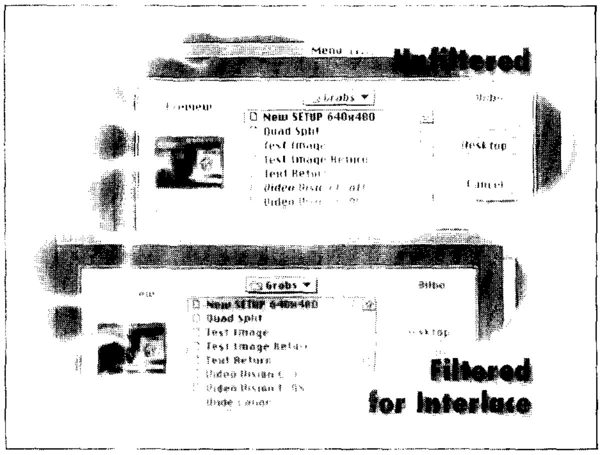
Analog television has always been sampled vertically because of the use of a scanning line structure. As we are dealing with a digital television standard, which will be sampled both vertically and horizontally, sampling theory should be used as the basis for these discussions. The ability to present information on all forms of display, *with* or *without* spatial and temporal aliasing artifacts lies at the heart of this debate.

To accurately represent content, without aliasing, samples must be optimized for the target display, be it a scanned CRT or the color separations in this magazine. Aliasing artifacts may include stairsteps on the diagonal and curved edges of an object, twitter or strobing in moving objects, and small-area and large-area flicker. Samples that are optimized for one display system—e.g., a progressive-scan display—may cause aliasing artifacts if they are presented on another display system—e.g., an interlaced display. To eliminate these aliasing artifacts it is necessary to resample (filter the information) to match the requirements of the target display device.

An interlaced display cannot present as much information as a progressively scanned display with the same number of scan lines and temporal refresh rate—e.g., 640 x 480 at 60 fields/sec versus 640 x 480 at 60 frames/sec. According to a paper on the interlace factor, published in the *Journal of the Society of Motion Picture and Television Engineers*, interlace offers little or no resolution advantage over half the lines progressively scanned.

Herein lies a major problem. Once you throw away information it's difficult, but not impossible, to get it back. If the information that is broadcast is optimized for a proscan display it is relatively easy to resample the image to prevent aliasing on an interlaced display. The higher frequencies that cause the aliasing artifacts can be removed with inexpensive analog or digital filters. If the information has been optimized for an interlaced display it is relatively difficult to resample the image to prevent aliasing on a progressive scan display. It must be de-interlaced to prevent temporal aliasing artifacts. And, to take full advantage of "the sharper image" possible on the proscan display, it is necessary to calculate new image samples. These are complex processes that are better handled by a sophisticated device at the broadcast site than in the cost-constrained consumer receiving device.

Aliasing is not always a problem—the computer industry has learned that in many applications improved contrast with aliasing is preferred to reduced contrast without aliasing. A computer can generate samples in a manner appropriate for the application—with or without aliasing. The industry uses the term *pixels* interchangably with *samples*, although it is not uncommon for a display medium to use multiple pixels to represent a single sample. For an excellent tutorial on pixels, see Mark Schubin's column "Pixel Pictorial" (VIDEOGRAPHY 12/95).



A computer can generate horizontal lines one television scan line in height by placing black samples over a background of white samples. This produces the maximum contrast possible on the target display; it may also produce severe aliasing artifacts on an interlaced display if the image is not properly filtered.

Vertical lines one sample in width are not a problem on CRT displays using interlaced horizontal line scanning, but horizontal lines one sample in height will flicker obnoxiously. In order to create a horizontal line with maximum contrast (i.e., using black samples) the thickness of the line must be increased to three samples—grey/black/grey—to eliminate the flicker; in the computer world this is known as *antialiasing*.

Antialiasing, as the term implies, is a form of filtering used to optimize samples for the characteristics of the target display. The use of filtering to reduce aliasing limits contrast and the frequencies that can be represented. A computer can create samples to represent information with high contrast and aliasing, or reduced contrast without aliasing. A major reason that the computer industry has strongly advocated the use of progressive-scan displays is that it allows information to be represented both ways, to support multiple applications.

As reported by Mark Schubin in "A Bird In the Bush?" (11/95), in a recent study viewers preferred high contrast ratios to higher detail resolution in comparisons of high resolution and standard resolution television displays. The research was conducted by RAI Centro Ricerche (the research division of Italy's major broadcast network); the findings were presented at the 1995 International Conference on Consumer Electronics, in a paper entitled "The Impact Of Display Parameters On The Quality Perceived By The Viewers," written by Ardito and Massimo Gunetti.

The research was conducted with a 38-in. 16:9 HDTV screen at two viewing distances: the DVD (design viewing distance) for HDTV of three picture heights (3H); and the PVD (preferred viewing distance) for a 38-in. screen of about five picture heights (5.2H).

When given the opportunity to freely choose the viewing distance in an environment without constraints, previous studies found that the PVD is primarily a function of screen size. According to the paper, "A 12-in. screen was found to have a PVD of about 8H; for a 38-in. screen PVD was about 5H; the PVD approaches to 3H for 160-in. or larger, screen." Although it wasn't stated in the paper, I assume that these dimensions refer to the screen diagonal.

The tests compared the subjective picture quality of HDTV with 720 pixel horizontal definition standard resolution television (SDTV). Viewers were shown a variety of source images under the following conditions: an equal contrast ratio for the SDTV and HDTV images, and four decreasing levels of contrast ratio for the HDTV images.

You may be asking "Why test decreased contrast ratio for HDTV?" You'll find part of the answer in Schubin's "Pixel Pictorial" column (12/95). CRT displays are scanned using electron beam(s) with Gaussian spot characteristics—the intensity of the spot helps determine the display brightness. All things being equal, as CRT display resolution is increased, the contrast ratio decreases.

The RAI research found that at the PVD: "due to the higher viewing distance, the contribution of HDTV, also in the case of full contrast ratio, becomes almost negligible. Moreover, if the HDTV contrast ratio decreases, SDTV pictures are rated better.

"In conclusion: the results of this study indicate that to fully exploit HDTV potential, displays with high contrast and great sizes are needed."

In turn, this leads me to conclude that a properly designed DTV system—without interlace—can deliver *the sharper image* using affordable display technology that exists today. The next logical step in the evolution of television is progressive-scan SDTV, with an interoperable and extensible path to HDTV for the applications that require and can economically support it. This will allow DTV to serve both the computers and televisions in our homes. And for those who cannot, or choose not, to afford both, one information appliance could be used to provide the benefits of computer and video convergence, whatever they turn out to be.—CRAIG BIRKMAIER

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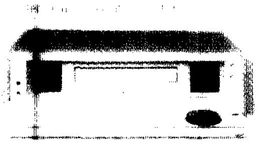
SANYO

GVR-S950 S-VHS Single Frame Recording VCR



- Built-in single frame animation ... standard protocols ... tion software package
- SMPTE time code generator/reader ... Read/Write ... the front panel
- Video and Audio switcher with two independent Video ... Each video channel contains both composite and S-Video inputs ... channel contains two linear and two Hi-Fi inputs. Switching ... either manually or under RS232 or RS422 control ... are switched independently letting you perform break away edits
- Auto-Sensing Single RS422/RS232 Input eliminates the need for ... interfaces. Interface requirements are automatically sensed and adjusted ...
- Input and Playback Video Processor allows adjustment ... adjusted during playback

GVR-S955 S-VHS Single Frame Recording VCR

All features of the GVR-S950 PLUS: The GVR-S955 contains a ... Unlike the GVR-S950, the GVR-S955 can be programmed via the RS-422 bus to complete ... breakaway feature ... code can be added to tapes with existing video.

Panasonic

AG-2540

Industrial 4-Head VHS Hi-Fi VCR

Same exact features as the AG-1300 plus:
- Super jog/shuttle puts 19-step ... over playback speed at your fingertips, giving you greater control while searching for scenes.
- Hi-Fi stereo sound system with ... range of more than 90 dB

NEW! AG-1980 S-VHS Hi-Fi Editing VCR

Incorporating advanced digital signal processing and digital noise reduction circuitry the new AG-1980 delivers such high picture quality—that it's third-generation picture looks almost as good as first-generation offerings from other VCRs in it's class. In addition to it's incredible video quality, the AG-1980 also features a full field digital TBC, insert and assemble editing, Hi-Fi stereo, quick response mechanism and a remote editing terminal.

- Still the only VCR in it's class to provide near frame accurate editing. When used with edit controllers from Videonics, FAST and FutureVideo the AG-1980 achieves ... rear panel makes it very easy to set up an editing system.
- Performs assemble and video insert edits as well audio video dubbing. Also ... more flexible audio dubbing.
- Hi-Fi stereo audio with a frequency response of 20Hz to 20kHz and a dynamic range of ... trol, headphone ... terminal with volume control and a mic input terminal.
- Digital Processing
  - Equipped with a Digital Comb Filter using an advanced 3-dimensional system the AG-1980 provides complete ... luminance/chrominance separation. This practically eliminates color and luminance blurring.
  - Field coefficient Digital Noise Reduction (DNR) circuitry processes the Y and C signals separately thereby boosting the signal to noise ratio and reducing noise during playback.
  - Has a built-in full field TBC (Time Base Corrector) that eliminates even the smallest of jitter, skew, head output error and color blurring. Invaluable for editing, the TBC helps maintain high picture quality even through third-generation.
- Besides it's digital circuitry, the AG-1980 also features laminated video heads. Clearly superior to heads of conventional ferrite they provide richer, more vibrant color reproduction and a higher signal-to-noise ratio.
- Advanced quick-loading mechanism features quick response time requiring only 0.5 seconds for a picture to appear from Stop mode and ... from FF/REW.

AG-5700

S-VHS Hi-Fi RS-232 Editing VCR

- Has amorphous video heads for higher signal-to-noise ratio
- Achieves an accuracy of ±3 frames with optional AG-A570 Edit Controller
- Built-in RS-232 provides machine control of playback, recording and editing functions from a computer. You can use the power of your computer (with optional software) to assemble hundreds of scenes, create edit decision lists and do complex editing jobs.
- Auto Repeat function continuously replays a tape which can be used for tape's end or ... recorded material ends
- Separate Hi-Fi (Ch 1 and 2) audio recording level controls with display. There is also a headphone output with volume control
- For unattended recording there is a Sensor Recording function. When a video signal is detected the power is automatically switched on and the AG-5700 begins recording
- For video presentations the AG-5700 is ready to go. Weighs less than 13 lbs, extremely compact with a built-in carrying handle
- User friendly design features record, play, and stop switches that are well illuminated for ... operation

AG-DS540/AG-DS550

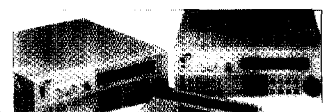
Professional S-VHS Source Player/ S-VHS Edit Recorder

NEW!

- 3-dimensional digital TBC with a correction range of one field. With the VCRs continuously retaining one field in memory, the data is used for 3-D type processing thereby providing excellent dropout compensation.
- Digital Signal Processing for improved picture quality, and for maintaining uniform picture quality during editing. Digital processing circuits include:
  - Chroma Aperture Compensation (CAC): Eliminates color blurring and expands chroma bandwidth
  - Digital Noise Reduction (DNR): Processes Y & C signals separately to boost S/N Ratio by minimizing noise during playback
  - Digital Comb Filter: Advanced 3-dimensional system for total Y/C separation providing reduced cross and luminance blurring
- Employs amorphous video heads that have a higher magnetic coercivity than conventional ferrite heads. Expanded frequency response ... amorphous heads enhances picture quality by minimizing blurring
- Built-in TC/VITC (Longitudinal/Vertical Interval) time code reader/generators for absolute frame accurate editing
- IQ (Intelligent Quest) mechanism delivers precise, high-speed operation. The dual-load ... system achieves high speed response while protecting tapes and heads. The tape transport mechanism uses five direct drive motors, including two reel drive motors
- Performs audio split editing which lets you set the edit-in and edit-out points separately for those for video
- Capstan Control System with large capstan spindle allows high-speed search at 32x normal speed (with color picture)
- 4 channel audio: 2 Hi-Fi stereo channels with dynamic range of 90dB as well as 2 linear channels with Dolby NR. Each audio channel has its own input (AG-DS550 only) and output with individual channel level ... capability and use XLR connectors
- Provide 16:9 wide aspect compatibility so they are fully equipped for the next generation of televisions
- 3 rack units high, they are both relatively compact for easy space saving installation. Rack-mountable with optional AG-M730.

JVC

S-VHS EDIT-DESK SYSTEM



BR-S500U Player • BR-S800U Edit Recorder RM-G800U Edit Controller

... new ... JVC's new ... editing system costing thousands ... the BR-S500U Player/Feeder, the RM-G800U Edit Controller and the BR-S800U Editing ... these three units offer ... editing features professionals have come to ... similar to that ... JVC's renowned "22 Series" ... the built-in CTL ... flexibility ...

OPEN ARCHITECTURE

... both VCRs ... controllers, plug-in ... the SA-K26U RS-422 ... include the SA-K28UA ... systems, the SA-R50U DNR board with time base stabilizer and the SA-R50U ... time code generator/reader.

CONTROL TRACK TIME CODE SYSTEM

Built-in ... BR-S800U ... time code reader/generator ... CTL (Control Track) Time Code system. This system records absolute tape address information ... frames) on the control track and provides fast and accurate access to any frame on the video tape. This is far superior to control track counters that lose reference when the tape is removed. CTL Time Code can be added to the tape during the recording process or "post striped". For professional SMPTE time code operation there is the optional SA-R50U VITC ... Generator card.

SUPERB VIDEO PERFORMANCE

Has latest picture improvement technologies for razor sharp images, with over 400 lines of horizontal resolution. Digital Y/C separation, chroma noise reducer, chroma aperture correction and a 3-line cross-talk cancellation all combine to offer outstanding image quality even when dubbing down multiple generations.

32X VARIABLE-SPEED SEARCH

Front-panel search dials featured on both the BR-S800U and BR-S500U provide fast accurate picture search at up to 32x normal speed. This is possible due to the incorporation of a heavy-duty direct drive mechanism similar to that used in JVC's "22 Series".

FOUR-TRACK AUDIO

Each features two Hi-Fi stereo channels with a wide frequency response and a dynamic range of over 80 dB and two linear tracks. The linear tracks of the BR-S800U can be dubbed independent of each other and of the video. This is ideal for adding background music or sound effects to an existing audio track. There are two audio level meters switchable between the Hi-Fi and linear channels. Separate input and output terminals are provided.

RM-G800U EDIT CONTROLLER

- Has two GPI ... automatic triggering of special effects generators, switchers or audio mixers
- Features auto ... assemble and insert editing, audio insert editing, as well as preview/review for checking edits before and after editing, and goto for direct access to any edit point. A capstan bump function is provided to assure greater edit consistency
- 8-digit LED counter indicates all edit data in either the TC or CTL mode. Switchable between player and recorder.
- The RM-G800U's jog control is precise and responsive, making it easy to locate any frame on the tape. You can enter the Jog mode directly and switch between the player or recorder at the touch of a button. The jog dial can also be used to enter and trim edit points ... from the ... points.

SONY

EVO-9720

Hi8 Dual Desktop Editing Machine

MULTI-EDITING CAPABILITIES

- The EVO-9720 provides two ways for assemble editing when using the supplied RM-9720:
  - Quick-Edit: By simply pressing the EDIT button at the desired point on the source tape, pressing END at the outpoint and repeating the process, a program is easily assembled, segment-by-segment on the master tape.
  - Program Edit: assemble video segments that are not adjacent to one another on the original source tape. The EVO-9720 can memorize up to 99 program events and realizes automatic sequential editing of preassigned scenes. To change a certain event in the program simply recall the event and modify as desired. The editing list of the program med time code data can be stored in the data area of the original source tape. The data can also be recalled, added, inserted or deleted as desired.
- Insert Editing: Provides separate video and audio editing.
- Using the video insertion function, video and AFM audio segments can be edited into an existing PCM (Pulse Code Modulation) digital sound track. To verify the edit, a simulated edit can be viewed by pressing the PREVIEW button before the edit is actually done.
- Allows audio dubbing on the PCM tracks. Background music or commentary can be added or inserted into the PCM sound track. During editing, audio from an external microphone can be mixed with the original audio from a player or from LINE IN and recorded on both the PCM and AFM audio tracks.
- Incorporates a built-in field memory allowing noiseless 1/5 normal speed slow motion pictures and a clear freeze picture to be played back during editing. This makes it possible to create a program with special effects.
- Has a built-in 8mm time code generator and reader. When using a tape without time code you can easily stripe time code by simply pressing the Time Code Write button. (Post striping of 8mm time code will not affect any of the video and audio signals) Can also ... RC ... (consumer) time code.

SUPERIOR PICTURE QUALITY

- The player portion of the EVO-9720 employs a digital noise reducer for luminance and chrominance signals, providing superior picture quality. Noise reduction levels are selectable from an on-screen display in accordance with picture conditions. CNR (Chrominance Noise Reduction) offers High, Middle, Low, and Off positions. YNR (Luminance Noise Reduction) offers High, Middle Low, Very Low and Off positions. Jitter and skew are eliminated at the same time to give clear, stable pictures.

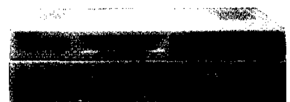
A/B ROLL EXPANSION CAPABILITY

- When you've outgrown the cuts-only functionality of the machine, the EVO-9720 lends itself to A/B roll expansion capability. Both the player and recorder have RS-232 serial ports that allow for external control. They can be directly connected as Source A and B to an external computer and/or the Sony FXE-100 Video Editing System.
- To further allow configuration into an A/B roll system there are external sync input terminals for both the player and recorder. When the external sync mode is set to Auto, the EVO-9720 synchronizes itself with the incoming reference signal.

ADDITIONAL FEATURES

- To provide for smoother transitions from scene to scene, the EVO-9720 has a video fader. Black or white fading can be selected as well as a duration time of 0.5 or 2 seconds.
- There is a GPI (General Purpose Interface) output with timing adjustment for controlling external devices. External devices like the Video Toaster or Character Generators can be controlled. GPI timing of between 00 and 60 frames is selectable.
- The EVP-9720 incorporates both PCM (Pulse Code Modulation) stereo and AFM (Audio Frequency Modulation) stereo recording for superb sound quality. PCM audio can be inserted or re-recorded for audio only edits in the Audio Insert mode.

EVO-9850 Hi8 Editing Recorder



- For enhanced picture quality, there is a built-in digital noise reducer for both the chrominance and luminance signals. In the CNR (Chrominance Noise Reducer) mode you can select low or high level of noise reduction according to picture conditions.
- Equipped with four channels of audio. Two AFM Hi-Fi stereo tracks plus two PCM digital stereo tracks. Each channel has balanced XLR inputs and outputs, plus there is individual level volumes for each track.
- Assemble and insert editing modes. In the insert mode there is independent editing of video, PCM 1, PCM 2 and time code.
- Built-in TBC (Time Base Corrector). With TBC the EVO-9850 outputs highly stable video signals. A digital drop-out compensator is also built-in. TBC adjustments can also be remotely controlled with the optional BVR-55 TBC Remote Control Unit.
- Absolute frame accuracy for video editing and single frame recording. Accuracy of ±0 frames is achieved with advanced servo system, quick response mechanism and built-in 8mm time code reader/generator.
- The EVO-9850 is equipped with a built-in 8mm time code generator. Since the 8mm time code is recorded between the video and the PCM audio tracks in a separate and dedicated location, 8mm time code insertion or overwrite is possible without losing a generation. An RS-422 9-pin connector is utilized for communicating edit command and time code data. The 8mm time code is output as SMPTE time code through the RS-422 connection to the edit controller.
- With the optional BVBK-100 the EVO-9850 inputs and outputs SMPTE time code data via BNC connectors. Accordingly the EVO-9850 can feed time code to another VCR or can lock to an external time code.
- The Jog/Shuttle mode provides high speed picture search from -17 to 17 times normal speed.
- To minimize picture deterioration during the editing process, the EVO-9850 incorporates Dub In/Out (7 pin) connectors.
- With the optional RMM-980, the EVO-9850 can be installed into a 19-inch EIA standard rack.
- External sync input to lock onto external reference video signals. This allows for synchronization with other video equipment.
- For customized operation there is a Dial Menu. You can set VCR operation modes like time code preset, time code superimpose, self diagnosis display, with the search dial.

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